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INVESTIGATIONS ON LIGHT AND HEAT, MADE AND PUBLISHED WHOLLY OR IN PART WITH  
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## XI.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF THE  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

## XXII.—COLORED MEDIA FOR THE PHOTOGRAPHIC DARK ROOM.

By WILLIAM H. PICKERING.

Communicated May 13, 1885.

SINCE the advent of the gelatine dry plate, many photographers have complained that their eyes are injured by the dark red light generally used in development. Considerable discussion of this subject has been aroused of late, but the only experiments made, as far as can be learned, have been to determine how much plates fog when exposed at the *same distance* to the various media tried. The experimenter then examines some object at that distance, and if he thinks he can see it about as well, and the plate is less fogged, the medium is pronounced an improvement.

In order to obtain more satisfactory results the following problem was proposed:—For a given distinctness of vision, what medium, or combination of media, will give the least fog on a gelatine plate? In order to determine at what distance from the lights equal distinctness of vision was obtained, a negative having some fine markings upon it was held at such a distance from the various sources that the details were just distinguishable from one another. Different portions of a sensitive plate were then exposed at these distances, one after another, to light coming through the different media, and the plate was then developed. Exposures with both daylight and gas-light as sources were made on the same plate, and, as was to be expected, those made by daylight were much the most fogged. If more colored glass was used, the daylight was too faint. So, for this reason alone, gas-light would be preferred. Add to this, that, if the gas-flame be placed at the bottom of a properly constructed flue, it will serve to ventilate as

well as light the dark room; and also that it can be used in the evening and on dark winter afternoons when daylight is out of the question. Moreover, since the gas-flame is much more uniform in brilliancy, it is correspondingly easier to determine when a plate is properly developed, and fewer plates are lost in this way.

Experiments with the following media have been made, and are numbered in the second and third columns in the order of their desirability. It will be noticed that there are five media which with gas-light give better results, i. e. less fog, than the best medium with daylight. In the second series the third column gives the distance in inches in each case at which the fine details were visible from the gas-flame. No medium is wholly satisfactory with daylight unless it contains red glass or paper. The window used with the gas-light measured six by seven inches, and was situated fourteen inches from the gas-flame. The window used with daylight measured five by five inches. Direct light from the clouds was used. The plate was developed in the first series with oxalate, and in the second with pyro and soda developer.

## FIRST SERIES.

Colored Media.	Gas.	Sky.
Red and yellow glass . . . . .	1	12
Red and ground glass . . . . .	2	6
Post-office paper . . . . .	3	14
Red glass . . . . .	4	8
Yellow glass double . . . . .	5	16
Yellow and violet glass . . . . .	7	18
Carbutt's red paper . . . . .	9	10
Red glass double . . . . .	11	13
Yellow and green glass . . . . .	15	17

## SECOND SERIES.

Colored Media.	Gas.	Inches.
Canary paper double . . . . .	1	8
Golden fabric double . . . . .	2	29
Red glass . . . . .	3	38
Golden fabric single . . . . .	4	58
Red, yellow, and ground glass . . . . .	5	11
Red and yellow glass . . . . .	6	22
Canary paper single . . . . .	7	19
Post-office paper . . . . .	8	15
Yellow and green glass . . . . .	9	41

It was found that ground glass transmitted fifty-five per cent of the light from a gas-flame coming through red glass, while it transmitted

only about nine per cent of daylight under similar circumstances. Its effect is therefore similar to yellow glass. The fact that the yellow-violet combination was so satisfactory with the gas-flame was probably due to the capacity of the yellow to cut off the small amount of violet emitted by this source, while it was quite inadequate to destroy it in the case of daylight, as is indicated by the figures. The precise order here given is not insisted on, but only the general sequence, as in the case of most of the media there was very little difference in their desirability, and sometimes the position of two media on the list would be reversed by a negative. One fact was brought out, however, with great distinctness in all the series, and that was the great inferiority of the yellow-green combination. This was of course to be expected, but, as many photographers still use this medium in their dark rooms, it was considered desirable to include it in the list, merely to show its inferiority. Although in the second series Canary paper double seemed to give the least fog of any of the media, the light transmitted by it proved to be so faint that it was quite inadequate for satisfactory illumination of the dark room; and, owing to its opacity, some doubt was cast on the accuracy of the observation. The second medium on the list has therefore been selected as the best practical one to employ with gas-light illumination. Its color is very pleasant to the eyes, and being translucent, instead of transparent, it lights the whole room in a very satisfactory manner. It is advisable to place it behind a sheet of glass, in order to protect it from being soiled by the chemicals employed. If one is obliged to use daylight as a source of light, it is probable that a sheet of red glass in connection with one or two thicknesses of Golden fabric would form as satisfactory a combination as any.

Experiments were next made to determine how bright a light is permissible with the medium adopted. The fish-tail burner which was used on the gas-lamp was placed fourteen inches behind a double sheet of Golden fabric, measuring twenty-four by sixteen inches. An extremely sensitive gelatine plate was placed at a distance of twelve inches in front of the medium, and a portion of it exposed for one minute. It was found, that if the gas-flame measured only one inch in height, not the least trace of fog was produced by the exposure. This is too faint a light for satisfactory use, however, and as a very minute amount of fog does not injure a negative perceptibly, and the direct exposure to the light in actual practice is much less than a minute, the flame is turned up to a height of an inch and a half or two inches for ordinary development. By this light one can readily see to

read the finest type, and the light pervading the whole room is very satisfactory. After a short exposure to it, in fact, it seems almost like white light.

In this connection may be mentioned a device which has proved very useful as an auxiliary in enabling one to judge of the proper development of a negative. A square hole measuring an inch and a half on a side is cut in the upper portion of the Golden fabric, and a piece of red glass inserted between the two thicknesses. If a negative be now held near this hole, a red square of light will be cast upon it. This square can be seen even when the lights of the negative are quite intense, and by noting its distinctness, one can judge of the opacity of the high lights as accurately as he can of the details of the shadows of the picture. If the high lights reach their proper intensity first, he develops for the shadows, and *vice versa*.

As the whole question of the proper medium to use resolves itself merely into what part of the spectrum to employ, red, orange, or orange-yellow, and all three of these yield nearly equally good results, it is evident that no important improvement can be made in the future. But as the orange-yellow is much the pleasantest light of the three, and seems to give rather less fog than either of the others, it is the color to be recommended. Any medium which will transmit this color will be found satisfactory, but Golden fabric is perhaps as convenient as any.

A very portable form of lantern to be used when travelling consists of a strip of Golden fabric a foot wide by two and a half in length. When one wishes to use it, it is rolled into a cylinder a foot long, and five inches in diameter, and pinned. A kerosene lamp with the wick turned down low, or a candle, is then placed inside, and the lantern is complete. The circle of white light formed on the ceiling is not bright enough to do any harm. The lantern is set several feet away from the exposed plates, and they should in general be protected as much as possible from direct illumination. There is then plenty of light, and yet not the slightest danger of fog.